CLAIMS

1. A supermolecular structure comprised of a host material and impurities such that the positions of component atoms are substantially fixed to impart substantially predictable properties to the structure, the structure also being described by the formula:

$H_A \Sigma X_{ia}$

wherein:

H defines the host material;

A is a number representing the number of host atoms in the structure;

X defines the i^{th} impurity; and

a defines the quantity of the i^{th} impurity.

2. A pn junction formed from the supermolecular structure of claim 1.

3. The pn junction of claim 2 further comprising:

an insulating substrate on which the supermolecular structure is disposed; and

contact electrodes connected to the supermolecular structure so that the pn junction forms a stand-alone device.

4. A bipolar cell formed from the supermolecular structure of claim 1.

5. The bipolar cell of claim 4 further comprising:

an insulating substrate on which the supermolecular structure is disposed; and

contact electrodes connected to the supermolecular structure so that the bipolar cell forms a stand-alone device.

6. A single charge oscillator array comprising a plurality of electrostatically coupled supermolecular structures, each structure further comprising a host material and impurities such that the positions of component atoms are substantially fixed to impart substantially predictable properties to the structure, each structure also being described by the formula:

$H_A \Sigma X_{ia}$

wherein:

H defines the host material;

A is a number representing the number of host atoms in the structure;

X defines the i^{th} impurity; and

a defines the quantity of the i^{th} impurity.

7. A single-dopant pn junction comprising:

a host structure;

a single donor atom disposed at a first side of the host structure; and

a single acceptor atom disposed at a second side of the host structure, the second side being opposite the first side, the single donor atom and single acceptor atom being positioned so that a single dipole is created within the host structure.

8. The single-dopant pn junction of claim 7 further comprising:

an insulating substrate on which the host structure is disposed; and

contact electrodes connected to the host structure so that the single-dopant pn junction forms a stand-alone device.

9. A single-dopant bipolar cell comprising:

a host structure;

a pair of atoms of a first type disposed so that a single atom of the pair resides at each of two opposing sides of the host structure; and

a single atom of a second type disposed between the atoms of the first type within the host structure so that two asymmetrical potential wells, separated by a barrier, are formed within the host structure.

10. The single-dopant bipolar cell of claim 9 wherein the first type of atom is an acceptor and the second type of atom is a donor.

11. The single-dopant bipolar cell of claim 9 wherein the first type of atom is a donor and the second type of atom is an acceptor.

12. A semiconductor device comprising:

an insulating substrate;

a host structure disposed upon the insulating substrate;

a pair of atoms of a first type disposed so that a single atom of the pair resides at each of two opposing sides of the host structure;

a single atom of a second type disposed between the atoms of the first type within the host structure so that two asymmetrical potential wells, separated by a barrier, are formed within the host structure; and

contact electrodes connected to the host structure.

13. The semiconductor device of claim 12 wherein the first type of atom is an acceptor and the second type of atom is a donor.

14. The semiconductor device of claim 12 wherein the first type of atom is a donor and the second type of atom is an acceptor.

15. A single charge oscillator array comprising a plurality of electrostatically coupled, single-dopant bipolar cells, each cell further comprising:

a host structure;

a pair of atoms of a first type disposed so that a single atom of the pair resides at each of two opposing sides of the host structure; and

a single atom of a second type disposed between the atoms of the first type within the host structure so that two asymmetrical potential wells, separated by a barrier, are formed within the host structure.

16. A semiconductor oscillator comprising:

an insulating substrate;

a single charge oscillator array disposed upon the insulating substrate;

contact electrodes connected to the array; and

a thermal energy supply system for maintaining an operating temperature of the array at least as high as a threshold temperature.

17. The semiconductor oscillator of claim 16 wherein the single charge oscillator array further comprises a plurality of electrostatically coupled supermolecular structures, each structure further comprising a host material and impurities such that the positions of component atoms are substantially fixed to impart substantially predictable properties to the structure, each structure also being described by the formula:

$H_A \Sigma X_{ia}$

wherein:

H defines the host material;

A is a number representing the number of host atoms in the structure;

X defines the i^{th} impurity; and

a defines the quantity of the i^{th} impurity.

18. The semiconductor oscillator of claim 16 wherein the single charge oscillator array further comprises a plurality of electrostatically coupled, single-dopant bipolar cells, each cell comprising:

a host structure;

a pair of atoms of a first type disposed so that a single atom of the pair resides at each of two opposing sides of the host structure; and

a single atom of a second type disposed between the atoms of the first type within the host structure so that two asymmetrical potential wells, separated by a barrier, are formed within the host structure.

19. Apparatus for supplying oscillations comprising:

means for supplying thermal energy to maintain an operating temperature of the apparatus at least as high as a threshold temperature;

means for generating coherent oscillations in response to the thermal energy;

means for insulating and supporting the means for generating; and

means for connecting the apparatus to external circuitry, the means for connecting connected to the means for generating.

20. A method of fabricating a single-dopant, bipolar cell on a substrate of a semiconductor material, the method comprising the steps of:

placing a single three-atom set of dopants on the substrate;

growing an epitaxial film of the semiconductor material over the set of dopants and the substrate; and

passivating the cell with at least one monolayer.

21. The method of claim 20 wherein the three-atom set of dopants is placed by a proximity probe manipulation technique.

22. A method of fabricating a plurality of single-dopant bipolar cells on a substrate of a semiconductor material, the method comprising the steps of:

placing two or more single three-atom sets of dopants on the substrate;

growing an epitaxial film of the semiconductor material over the sets of dopants and the semiconductor substrate;

producing a pattern at the surface of the epitaxial film, the pattern defining a shape for the cells; and

passivating the plurality of single-dopant bipolar cells with at least one monolayer.

23. The method of claim 22 wherein the three-atom sets of dopants are placed by a proximity probe manipulation technique.

25. A method of fabricating a single-dopant bipolar cell by forming a vertical, three-atom set of dopants, the cell being formed on a substrate of semiconductor material, the method comprising the steps of:

placing a first atom of a first type on the substrate;

growing a first epitaxial film of the semiconductor material over the first atom and the substrate;

placing a single atom of a second type atop the first epitaxial film;

growing a second epitaxial film of the semiconductor material over the single atom of the second type and the first epitaxial film;

placing a second atom of the first type atop the second epitaxial film so that the three-atom set is formed;

growing a third epitaxial film of the semiconductor material over the second atom of the first type and the second epitaxial film; and

passivating the cell with at least one monolayer.

26. The method of claim 25 wherein the first atom of the first type, the single atom of the second type, and the second atom of the first type are all placed by a proximity probe manipulation technique.

27. A method of fabricating an plurality of single-dopant bipolar cells by forming vertical, three-atom sets of dopants, the cells being formed on a substrate of semiconductor material, the method comprising the steps of:

placing two or more first atoms of a first type on the substrate;

growing a first epitaxial film of the semiconductor material over the first atoms of the first type and the substrate;

placing a plurality of single atoms of a second type atop the first epitaxial film;

growing a second epitaxial film of the semiconductor material over the single atoms of the second type and the first epitaxial film;

placing a plurality of second atoms of the first type atop the second epitaxial film so that three-atom sets are formed;

growing a third epitaxial film of the semiconductor material over the second atoms of the first type and the second epitaxial film;

producing a pattern at the surface of the third epitaxial film, the pattern defining a shape for the cells; and

passivating the plurality of single-dopant bipolar cells with at least one monolayer.

28. The method of claim 27 wherein the first atoms of the first type, the single atoms of the second type, and the second atoms of the first type are all placed by a proximity probe manipulation technique.